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Detection and Monitoring of Air Pollution in Paper Industry

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ABSTRACT

Air pollution is one among the different types of pollutions that causes damage to the environment. The main sources for the air pollution are industries, vehicles etc. As the industries are growing in a higher rate here a pollution monitoring system is developed using Graphical User Interface (GUI) for continuous monitoring of pollutants emitted from the paper industries. Initially the system is trained with different range of pollutant data's using Adaptive Neuro Fuzzy Inference System (ANFIS) and a GUI panel is created with a space for entering different parameters and to showcase various conditions such as ecofriendly, moderate and over pollution conditions. By using this method the range of different pollutants can be controlled which in turn controls the overall pollutions emitted directly to the environment from the industries.

KEY WORDS: GRAPHICAL USER INTERFACE, POLLUTANTS, MONITORING, ADAPTIVE NEURO FUZZY INTERFACE

INTRODUCTION

In the present senario the industries are growing at a faster rate.From all these industries different kinds of pollutants are emitted day to day in air, water, soil etc. This project mainly aims to monitor (Vijnatha Raju 2013) and control the air pollution. Due to the different kind of air pollutants like carbon monoxide, carbon

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*Corresponding Author: monitnpl@gmail.com Received 25th Dec, 2018 Accepted after revision 26th March, 2019 BBRC Print ISSN: 0974-6455 Online ISSN: 2321-4007 CODEN: USA BBRCBA Thomson Reuters ISI ESC / Clarivate Analytics USA and Crossref Indexed Journal NAAS Journal Score 2019: 4.31 SJIF 4.196 A Society of Science and Nature Publication, Bhopal India 2019. All rights reserved. Online Contents Available at: http://www.bbrc.in/ DOI: 10.21786/bbrc/SI/12.3/9 dioxide, sulphur dioxide, hydro carbons, oxidants, dust and smoke emitted in the environment it causes different kinds of diseases to the human beings such as respiratory problem, carcinogenic effect, lachrymatory effect, allergic problem, irritation of eyes, appetite and visual diffculties. It also causes certain problem to the atmosphere such as acid rain , corrosion of metal, green house effect and also spoils the buildings (Deepak Shankar

35

Monisa, Gowthami and Kiruthika

2013). So to have a control of pollutants not to being emitted in the environment a continous monitoring system is developed. Here from a paper industry the pollutant data's are collected. For that a lower and a higher range is specified for each pollutants inorder to monitor them continously. This data base is uploaded for creating a Adaptive Neuro Fuzzy Inference based pollution monitoring system. A ANFIS based systemis given with three output conditions such as eco-friendly, moderately polluted and over polluted (Monisa et al. 2015). By monitoring continously the range of values for the pollutants can be maintained within eco-friendly condition.

MATERIALS AND METHODS

A. MONITORING SYSTEM FOR POLLUTANTS IN PAPER INDUSTRY

At present in the paper industry they are using a pollution monitoring system with the sensor and interface card which is shown in the Figure 1.



In the paper industry the main 7 parameters such as NO, NO_2 , H_2S , SO_2 , humidity, temperature and solar which are to be monitored are connected to an 8 channel ADAM CARD. Initially these parameters are measured with the sensors and as they are connected to the ADAM CARD the sensed signals are converted to electrical signals with a range between 4-20 mA.

And an 8 port MOX CARD is connected with the analyzers. This MOX CARD acts as an interface between the input sensor and the analyzer. The analyzer is the one which calculates the range for each and every input parameter and gives the output values in the form of different constraints such as particulate material, methane, hydrocarbon etc. This analysis of pollution is done only 8 hours once in the paper industry. Thus the corrective action is also done after 8 hours only. So the major defect identified here is immediate monitoring and control of pollutants cannot be done which leads to the cause of huge damage in the atmosphere. So here a solution for that problem is identified. For the continuous monitoring of pollutants ANFIS is used where the individual data's collected from the industry are given with a range and trained.

Then a GUI panel is connected with the ANFIS for a continuous monitoring so that we can identify correctly the over polluted condition then and there and the control of pollution can be established by changing the input parameters range.

B. PARAMETERS TO BE MONITORED

In the paper industry which is chosen here, that discharges different kind of pollutants to the atmosphere which in turn causes major change in the atmosphere as well as to the humans. So to control them within a range some parameters are chosen here such as oxides of nitrogen, hydrogen sulphide, sulphur dioxide, solar, temperature and humidity. These parameters are monitored continuously and there higher range values are clustered within over polluted output condition (Navreetinder Kaur 2016). The lower ranges of values are given within eco-friendly output condition and finally the moderate values are mentioned with moderately polluted output condition. The cause and the effect of each of these parameters are listed one by one.

I. OXIDES OF NITROGEN (NOX)

The main source for the oxides of nitrogen is from the combustion of wood, automobiles, fertilizers and industries. This pollutant causes respiratory problem and green house effect.

II. NITROGEN OXIDE (NO)

Nitrogen oxide is produced by the combination of nitrogen and oxygen during the combustion process. It causes severe respiratory problems such as asthma when a human is exposed to a short team. And chronic disease, when a human is exposed in a long term.

III. NITROGEN DIOXIDE (NO,)

Nitrogen dioxide is one kind of primary pollutants emitted from the paper industry. This primary pollutant will be directly emitted and they remain for a long time in the chemical form in which they are emitted.

IV. HYDROGEN SULPHIDE (H₂S)

The hydrogen sulphide is a colorless gas and it causes rotten egg smell. The main source of it is industries. And this can cause dizziness, severe headache and irritation to the humans.

V. SULPHUR DIOXIDE (SO,)

Sulphur dioxide is also a type of primary pollutants which is emitted directly from the industry. This causes several defects to the humans and environment such as respiratory irritation, irritation of throat and eyes and it leads to acid rain.

VI. SOLAR

Solar is a one with which the majority of the equipments will be powered in the industry. So for measuring the pollutants the power given to the input sensor, ADAM CARD etc. So the value of solar is needed to be measured.

VII. TEMPERATURE

Temperature is a one parameter with which the pollutants content will also vary. Because the degree of hotness or coldness will be a cause for spreading the pollutants into the environment. So the temperature has to be measured.

VIII. HUMIDITY

Humidity gives the range of moisture content present in the atmosphere. This is indirectly proportional to the temperature. So the value of humidity is important while measuring the pollutants.

C. REAL TIME DATA'S FROM INDUSTRY

For making efficient pollution monitoring the real time data's were obtained from the paper industry which is shown in the Table 1. The minimum and maximum ranges of all the input values are highlighted separately and by which the moderate values are found. So these ranges of values are given to the ANFIS and the system is trained to give three output conditions namely ecofriendly, moderately polluted and over polluted.

Table 1. Real time pollutant datas						
NO	No ₂	H ₂ S	SO ₂	HUMIDITY	TEMP	SOLAR
1.2	2.1	0.7	0.5	33.1	15.4	19.2
2.1	3.4	2.6	1.9	46	20.8	38.4
3.6	4	5	5.2	47.8	22.9	41.8
5.9	9.1	9.7	9.6	73.4	34.8	78.2
8.1	11.8	13.5	12.5	90.7	45.9	95.6

D. ANFIS MODEL FOR POLLUTION MONITORING

Adaptive Neuro Fuzzy Inference system (Arushi Singh 2017) is a one type of artificial intelligent technique. In

BIOSCIENCE BIOTECHNOLOGY RESEARCH COMMUNICATIONS

Monisa, Gowthami and Kiruthika

this once the data are feed and the system is trained it gets a capacity to take the decision by itself for any other inputs given but within the trained specific range. Here such a system is created for pollution monitoring in the paper industry (Monisa et al. 2018). The block diagram of that pollution monitoring system is shown in the Figure 2. The basic idea here is all the parameters which are to be monitored are connected to a pollution monitoring system which has an link with the ANFIS were the training and testing of input data is done. Then it is also connected with GUI which displays the out conditions by fetching the values from the ANFIS. Based on this the output values are displayed within three conditions namely ecofriendly, moderate condition and highly polluted.



The ANFIS system consists of two major classifications such as Sugeno model and mamdani model. In mamdani model for creating the membership function the starting and the ending range of values has to be specified. But in the Sugeno model it automatically determines the starting and the ending range of the values by itself by using the input conditions given to the systems. So by using this Sugeno model a pollution monitoring system is created (Anjaiah Guthi 2003). And this is shown in the Figure 3. For every single input a



Monisa, Gowthami and Kiruthika

membership function is created. The membership function is derived from a real unit interval. And the range of values will be specified between 0and 1. So for all the inputs the starting and the ending values of the input membership data's are specified by the Sugeno model as by itself. In the GUI panel when the input data's are entered it compares with all the membership values and gives the output.

Figure 4 shows the membership function for input Nitrogen oxide.



Figure 5 shows the membership function for input Nitrogen dioxide.



Figure 6 shows the membership function for input hydrogen sulphate.



Figure 7 shows the membership function for input sulphure dioxide.



Figure 8 shows the membership function for input Humidity



Figure 9 shows the membership function for input Temperature.



Figure 10 shows the membership function for input Solar.





E. GUI MODEL FOR POLLUTION MONITORING

Graphical User Interface act as an interface with the human and the machine. GUI acts as a visual language platform for the operating system and software applications. It is a user friendly panel in which the user can see the input values and the output conditions simultaneously at the same time. And more than that the input values can be changed at anytime by the user. In this the output and the input can be viewed in the form of numeric values, text or graph. The added advantage to the GUI panel is that here the interface of any system can be done like fuzzy system, neural system etc. So in those systems the training of input data is done and the display of it is showcased in the GUI panel.

RESULT AND DISCUSSION

A GUI panel is like a user friendly display [10]. This panel is created for pollution monitoring which is shown in the Figure 11.

In this panel 7 spaces were created in the left for entering the input parameters and in the right side three spaces were created for displaying the output conditions.



And in the middle the ANFIS is interfaced with the GUI. Once the input data's are entered in the GUI panel using get value button the analysis button is pressed which compares the input value with the trained data's in the ANFIS and it displays the output conditions accordingly. With the help of that control of pollutants a can be accomplished.

CONCLUSION AND FUTURE SCOPE

From the paper industry different parameters to be monitored for controlling the air pollution are trained using Adaptive Neuro Fuzzy Inference system. And a GUI panel was created with the space for entering the input data's and to display output conditions. This GUI panel was interfaced with the ANFIS. And with the help of this GUI panel continuous monitoring is established successfully.

In future this work can be extended by separating the different pollutant data's accurately using Support Vector Machine.

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BIOSCIENCE BIOTECHNOLOGY RESEARCH COMMUNICATIONS

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